A Method of Transmitting a Data Packet

Technical field:

The invention relates to a method of transmitting a data packet from a first transmitting/receiving device to a second transmitting/receiving device.

The invention is based on a priority application DE 100 43 658.7 which is hereby incorporated by reference.

Background of the invention:

Data packets are transmitted for example in multiple access systems. A multiple access system has the form for example of a point-to-multipoint system, for example a HFC-system, HFR-system, LMDS-system, UMTS-system or hyperLAN-system; HFC = Hybrid Fibre Coax, HFR = Hybrid Fibre Radio, LMDS = Local Multipoint Distribution System, UMTS = Universal Mobile Telecommunications System.

In multiple systems, in particular delay-sensitive, low-bandwidth services generate only small bandwidths on the path from the terminals to the control centre. Such services are for example VoIP, request signals for web pages, request signals for SoD or the like; VoIP = Voice over Internet Protocol = telephony via the internet, SoD = Service on Demand = services such as videos, tutorial programs, music on request. The required bandwidths for the use of a service are distinctly below 64 kbit/s. At the same time however, stringent demands are made on the maximum delay jitter, for example in the order of magnitude of 1 to 4 ms.

Prior to each transmission of data packets from the terminals to the control centre, transmit authorizations, for example allocations of time slots, time intervals, codes, frequency channels or arbitrary combinations thereof, are transmitted from the control centre to the terminals. Only after the reception of a transmit authorization is a terminal allowed to transmit a data packet. The access method for the terminals is for example TDMA, CDMA, FDMA or any combination thereof, e.g. TFDMA; TDMA = Time Division Multiple Access, CDMA = Code Division Multiple Access, FDMA = Frequency Division Multiple Access, TFDMA = Time and Frequency Division Multiple Access.

If transmit authorizations are sent to a terminal at a low rate, for example a rate which corresponds to the traffic volume of a VoIP application, the time intervals between the individual transmit authorizations and the resultant delay jitter are very large. The delay jitter is for example greater than 10 ms and thus exceeds the permissible maximum.

To fulfil the delay jitter requirement, the rate of the transmit authorizations for each terminal is increased. However, the increased transmit authorization rate inevitably leads to a bandwidth provision which greatly exceeds the bandwidth of the expected traffic volume. In this way a large part of the bandwidth made available remains unused and therefore is wasted. Especially in radio systems in which little bandwidth is available, this has a disadvantageous effect, for example it distinctly limits the number of radio stations in a cell wishing to transmit data packets simultaneously.

Summary of the invention:

The object of the invention is to provide a method of transmitting a data packet which fulfils the delay jitter requirements and at the same time is optimised in respect of the bandwidth utilization.

This object is achieved by a first method of transmitting a data packet from a first transmitting/receiving device to a second transmitting/ receiving device, comprising the following steps:

a) transmission of at least two transmit authorizations from the second transmitting/receiving device to the first transmitting/receiving device;

b) transmission of the data packet from the first transmitting/receiving device to the second transmitting/receiving device following the reception of transmit authorizations

c) interruption of the transmission of transmit authorizations from the second transmitting/receiving device to the first transmitting/receiving device following the reception of the data packet.

The object of the invention is further achieved by a second a method for sending transmit authorizations from a first transmitting/receiving device to a second transmitting/receiving device, wherein the transmit authorizations are sent to the second transmitting/receiving device in a first time period and wherein the first time period is shorter than a second time period which adjoins the first time period and in which no transmit authorizations are sent to the second transmitting/receiving device. The object of the invention is further achieved by a control centre for a multiple access system comprising a control unit for the controlled transmission of transmit authorizations to transmitting/receiving devices, wherein the control unit is capable of sending at least two transmit authorizations to a transmitting/receiving device an of interrupting the transmission of the transmit authorizations to the one transmitting/receiving device as soon as the control centre has received a data packet from the one transmitting/receiving device.

In the first method according to the invention, transmit authorizations are transmitted at a high rate in order to fulfil the requirements in respect of the delay jitter. However the transmit authorizations are only transmitted as long as is necessary. Following the reception of a data packet of a terminal, the transmission of further transmit authorizations for the same terminal is interrupted. Only after a specified time period, i.e. shortly before the expected transmission of a data packet of the same terminal, are transmit authorizations again sent to this terminal at a high data rate. In this way short time periods, in which transmit authorizations are sent at a high rate to a terminal, alternate with long time periods in which no transmit authorizations are sent to this terminal. In the long time periods for example transmit authorizations can be sent consecutively, in each case in short time periods, to one, two or more further terminals.

The first method according to the invention can thus be referred to as a method of transmitting a data packet from a first transmitting/receiving device to a second transmitting/receiving device, comprising the following steps:

a) transmission of at least two transmit authorizations from the second transmitting/receiving device to the first transmitting/receiving device;

b) transmission of the data packet from the first transmitting/receiving device to the second transmitting/receiving device following the reception of transmit authorizations;

c) interruption of the transmission of transmit authorizations from the second transmitting/receiving device to the first transmitting/receiving device following the reception of the data packet.

The first transmitting/receiving device has the form for example of a terminal, cable modem or radio station of a multiple access system. The second transmitting/receiving device has the form for example of a control centre, head end or hub of a HFC- or HFR system, a control centre of a hyperLAN-system or a base station of a LMDS- or UMTS-system. The multiple access system is for example a point-to-multipoint system with a control centre and a plurality of terminals. The second transmitting/receiving device forms the control centre, while the first transmitting/receiving device forms a terminal. The access method for the terminals to the transmission channel to the control centre is centrally controlled. In the case of TDMA, the control centre confers transmit authorizations by allocating time slots in which a specified terminal is authorized to transmit. The central allocation serves to prevent collisions. The transmit authorizations and the data packets sent by the terminals are not synchronised with one another. The data packets of the terminals have a low data rate and upon their transmission a certain delay occurs which is different for different terminals due to the different distances between the terminals and the control centre. To fulfil delay jitter requirements, the transmit authorizations are transmitted at a high rate. Only after the reception of at least two transmit authorizations can each terminal effect a controlled transmission of a data packet such that the delay jitter requirement is fulfilled. From the received transmit authorizations, each terminal derives the items of information necessary for the purposive transmission of a data packet at a specific time. When a data packet from a terminal has arrived at the control centre, due to the fact that each terminal uses only a low data rate for the transmission of data packets, it is ensured that no further data packets are to be expected from the same terminal in a specific time period. The transmission of transmit authorizations for this terminal is thus interrupted as soon as a data packet has been received from the terminal.

Only when, after a specific time period which can be determined from the data rate of a terminal, a further data packet is expected, is the transmission of transmit authorizations for this terminal continued. In this way at least two transmit authorizations are sent from the second transmitting/receiving device, i.e. the control centre, to the first transmitting/receiving device i.e. a terminal, when a further data packet is expected from this terminal. Additionally, the transmission of the transmit authorizations from the second transmitting/receiving device to the first transmitting/receiving device is interrupted again as soon as the second transmitting/receiving device has received the further data packet.

The process of transmission of transmit authorizations and the interruption of the transmit authorizations continues for such time as the connection between control centre and terminal exists. If for example a terminal has dialled into the internet, the above process is continued until the end of the internet session.

As a result of the interruption of the transmit authorizations, time periods are generated which can be used for additional purposes. The bandwidth which is available between the transmission of data packets of a terminal can be used by other terminals for the transmission of data packets. Following the interruption of the transmission of transmit authorizations from the second transmitting/ receiving device, i.e. the control centre, to the first transmitting/receiving device, i.e. a first terminal, advantageously at least two transmit authorizations are sent from the second transmitting/receiving device to a third transmitting/receiving device i.e. a second terminal. The transmission of the transmit authorizations from the second transmitting/receiving device to the third transmitting/receiving device is interrupted as soon as a data packet from the third transmitting/receiving device has been received in the second transmitting/receiving device. In this way a transmission channel of a specific bandwidth can be used simultaneously by two terminals. For this purpose the terminals transmit in time-shifted manner under the control of the control centre. As a function of the available bandwidth of a transmission channel and the data rate of the terminals, the above procedure can be extended to three, four and more terminals, in which case three, four and more terminals can simultaneously use the same transmission channel in time-shifted manner under the control of the control centre.

Therefore in general it is possible to refer to a second method of transmitting transmit authorizations from a first transmitting/receiving device, for example a control centre, to a second transmitting/receiving device, for example a terminal, wherein the transmit authorizations are sent to the second transmitting/receiving device in a first time period and wherein the first time period is shorter than a second time period which adjoins the first time period and in which no transmit authorizations are sent to the second transmitting/receiving device. The time intervals between two transmit authorizations advantageously fulfil predetermined delay jitter requirements. At least in a time slot of the second time period, transmit authorizations can be sent to a third, fourth, fifth transmitting/receiving device.

The control centre according to the invention of the multiple access system comprises a control unit, for example an access-control controller, a MAC controller (MAC = Medium Access Control), a processor, a CPU, a software program on a computing unit or the like, for the controlled transmission of transmit authorizations to transmitting/receiving devices, for example terminals. The control unit is capable of sending a transmitting/receiving device at least two transmit authorizations and of interrupting the transmission of the transmit authorizations to the one transmitting/
receiving device as soon as the control centre has received a data packet of the one transmitting/receiving device. The control centre has the form for example of a head end or hub of a HFC- or HFR system, a control centre of a hyperLAN system, or a base station of a LMDS- or UMTS system. The transmitting/receiving devices each have the form of a cable modem or radio station.

Best mode for carrying out the invention:

In the following the invention will be explained in the form of an exemplary embodiment.

In the case of a VoIP application, a terminal generates for example a data rate of 10 kbit/s. In this way data packets containing voice information are transmitted at a data rate of 10 kbit/s. For this purpose the control centre of the multiple access system must make available a transmit authorization rate of approximately one transmit authorization every 40 ms. The delay jitter is not to exceed 4 ms for example. In the multiple access system this would result in a data rate of 106 kbit/s for the VoIP application. Due to the fact that the VoIP application requires only 10 kbit/s, 96 kbit/s of the 106 kbit/s remain unused. In accordance with the invention, however, the transmission of the transmit authorizations is interrupted after the reception of a data packet for the corresponding terminal. If the VoIP data packets arrive in the control centre for example with an inaccuracy of ± 4 ms, about 7 out of 9 transmit authorizations can be interrupted. The 7 potential transmit authorizations can be used for one, two or three further VoIP applications. Thus in the exemplary embodiment the bandwidth of a transmission channel made available is used simultaneously by up to four terminals for four VoIP applications. This corresponds to a four-fold increase compared to the prior art.

The generation of transmit authorizations or transmit permissions thus take place at a high rate in order to fulfil the delay jitter requirements. At the same time the transmit authorizations are sent to a specific terminal only in the time periods in which data packets are expected from this terminal. As soon as a data packet of a specific terminal has been received in the control centre, the transmission of the transmit authorizations to this terminal is interrupted. The invention thus consists of an intelligent control of the transmit authorizations which are generated at a high rate in order to fulfil the delay jitter requirements. The dynamic allocation of interrupted transmit authorizations of a terminal to other terminals serves to optimise the bandwidth utilization.